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THROMBOEMBOLIC STROKE IN A YOUNG STROKE POPULATION: CLINICAL CHARACTERISTICS AND PREDICTORS OF SHORT-TERM STROKE OUTCOME

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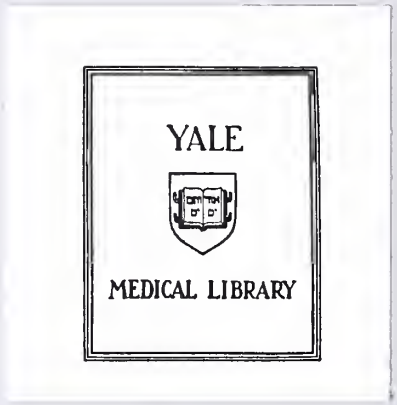
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THROMBOEMBOLIC STROKE IN A YOUNG STROKE POPULATION: CLINICAL CHARACTERISTICS AND PREDICTORS OF SHORT-TERM STROKE OUTCOME

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by

Guy William Fried

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ABSTRACT

THROMBOEMBOLIC STROKE IN A YOUNG STROKE POPULATION:

CLINICAL CHARACTERISTICS AND PREDICTORS

OF SHORT-TERM STROKE OUTCOME

Guy William Fried

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This is a retrospective study of first thromboembolic stroke in patients under 65 years old. The clinical data and head CT scan results of 100 stroke patients are presented together with predictors of short-term stroke outcome. Results from this study indicate that the demographic, clinical and paraclinical characteristics of a young stroke population are comparable to the general stroke population. Of special interest, there was a notably high prevalence of hypertension, diabetes mellitus, peripheral vascular disease and coronary artery disease in patients under 65 years old presenting with first thromboembolic stroke. Clinical variables found to be predictive of death during hospitalization for stroke include decreased level of consciousness and complete limb paralysis on admission examination, or a stroke in an anterior cerebral distribution. Head CT findings predictive of death during hospitalization include mass effect and bilateral hemispheric strokes. Clinical variables predictive of discharge to a rehabilitation or nursing facility include complete limb paralysis or decrease in mental status on admission, or a brainstem stroke. Paraclinical predictors of institutionalization following stroke include CT evidence of brainstem stroke and EKG conduction abnormalities.

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Introduction

The goals of this study are to: 1. Describe the characteristics of a young stroke population presenting with first thromboembolic stroke; and 2. Examine the presenting clinical characteristics and para-clinical data of patients less than 65 years old hospitalized with first thromboembolic stroke in order to identify features which predict short term stroke outcome. Identification of predictive characteristics is important because it allows the physician to optimize the patient's initial medical management, to plan rehabilitative services and to allow the patient and his family to prepare for the future.

Previous studies have attempted to identify features which predict short term stroke outcome. The association of neurological, and demographic features and the presence of co-morbid disease states on stroke outcome have been studied. Studies that have assessed neurological findings on clinical examination find that the following deficits on presentation with stroke predict a poor outcome: a decrease in consciousness;[1-6] the presence of conjugate deviation of the eyes; [2-4,6] and the presence of hemiplegia.[1,2,4] In addition to these findings other studies suggest that the presence of bilateral Babinskis,[6] a central facial[6] or abnormal pupils[3] on initial neurologic examination are associated with a poor stroke outcome. In these studies the length of time that

patients were followed ranged from three weeks to one year post stroke. The outcome events differed in each study and included length of hospitalization, disposition on discharge and survival following stroke.

Several studies[1,3,4,7] have found that advanced age predicts an increased mortality in stroke patients. It is unclear, however, if the increased mortality in older age groups is caused by the presence of comorbid disease states or if older age by itself carries a poorer prognosis. Khaw[7] found that a history of cigarette smoking was associated with increased mortality in stroke. However, other studies were unable to support this finding.[8]

Patients with other diseases states, specifically cardiac and vascular diseases, have been found to be at increased risk of dying from stroke. Miah[4] investigated the association of cardiac factors on stroke outcome and found that patients with a history of heart failure, angina pectoris, myocardial infarction or bundle branch block were more likely to die during hospitalization for acute stroke. Khaw[7] found, in a prospective study, that stroke victims with a prior documentation of a systolic blood pressure greater than 160 mmHg were more likely to die from their stroke than patients with documentation of lower systolic blood pressure.

A few studies have attempted to use head CT scan findings as outcome predictors for stroke. Miller[9] in a study of stroke patients admitted to a rehabilitation facility looked at location and

size of lesions. He classified lesions as deep (basal ganglion, internal capsule, thalamus) and superficial (cerebral hemispheres up to and including the external capsule). He found that deep lesions and lesions in the external capsule had a poorer prognosis for functional recovery.

Valdimarsson[10] looked at the site and volume of acute cerebral infarctions on head CT scan and the presence of mass effect. He found that in patients who were mildly disabled following stroke, CT scan results were not useful as a prognostic tool. However, severely disabled patients with a mass effect on CT scan always had a poor functional recovery.

In reviewing the studies on stroke outcome, the paper by Allen[1] is the most generally applicable. Allen prospectively studied a group of British patients less than seventy-six years old with acute stroke. The study population consisted of 148 consecutive patients admitted to the hospital for acute stroke. Only patients who survived the first twenty-four hours of hospitalization were eligible for the study. Outcome measures were noted at two and six months after hospitalization. The patients' overall level of functional recovery was assessed using a scale that measured the degree of independence they had achieved in the activities of daily living. The clinical variables that were correlated with poor outcome included decreased level of consciousness, higher cerebral dysfunction, hemiplegia, or hemianopia on admission and older age.

Using these characteristics, he developed a discriminant function for predicting stroke outcome.

It is difficult to compare findings in the existing studies or to apply the findings to other stroke populations for the following reasons: 1. Most studies are based on stroke populations selected according to eligibility criteria that are either not specified or so specific they cannot be duplicated in other settings; 2. Studies performed in the United Kingdom may have limited applicability to stroke populations in the United States. Due to cross national differences in health care practices, the majority of patients presenting with acute stroke in the United States are admitted to the hospital, whereas in the United Kingdom, only 40-60% of new strokes are hospitalized. It is reasonable to assume that in hospital based series, the clinical spectrum of stroke patients studied differs between the two countries. The clinical spectrum may include less severe stroke patients in the United States; 3. Criteria for defining the presence of stroke and distinguishing between stroke subgroups differed between studies. Most depended on clinical and paraclinical data that are associated with a high rate of misclassification. It is important to determine the case mix of cerebral infarctions and cerebral hemorrhages in stroke populations because there are significant prognostic differences between them; and 4. The studies measured different outcome events at varying time intervals following stroke.

In addition some studies analyzed clinically unselected variables resulting in correlations or predictive equations that are mathematically precise and statistically significant, but not clinically useful. Other studies included prevalent as well as incident cases of stroke in their study populations. This could influence the results of the studies because the prognosis for recurrent stroke is less favorable than that for first stroke.

This study was designed to overcome some of the problems of previous studies. Our study population was selected from all patients between the ages of 15 to 65 admitted to the Yale-New Haven Hospital for first cerebral infarction during the time period of the study. To be eligible for the study, all patients were required to have a CT scan within two weeks of the onset of stroke to rule out hemorrhagic stroke or other lesions that can present as stroke. A pilot study by Henrich found that 98% of stroke admissions at Yale-New Haven Hospital receive a CT scan within the first forty-eight hours. Patients with diseases known to be associated with an increased risk of embolic stroke such as atrial fibrillation, mitral stenosis, prosthetic valves, recent myocardial infarction and ventricular aneurysm were excluded from the study. Also excluded were patients who had left heart catheterization or cardiac angiography performed less than forty-eight hours prior to stroke onset and patients with hematologic disorders, vasculidities, or other disease states that would independently increase the risk of

stroke. Precise criteria were developed to define the presence of other disease states present in stroke patients such as hypertension, diabetes and atherosclerotic vascular disease.

Methods

The subjects and data for this project were taken from an ongoing study at Yale-New Haven Hospital which is assessing the relationship between migraine headache and thromboembolic stroke risk. One hundred consecutive subjects were selected from a cohort of patients aged 15 to 65 who were discharged from the Yale-New Haven Hospital between January 1, 1981 and December 31, 1984 with the primary diagnosis of thromboembolic stroke (ICDA codes 343.0, 434.1, 434.9, 436). Overall eligibility for cases in this study included: 1. A head CT scan performed during hospitalization or within two weeks of the onset of stroke; 2. A lack of known cardiac abnormalities recognized before CT scan that would independently increase the risk of embolic stroke such as atrial fibrillation, mitral stenosis, the presence of a prosthetic heart valve, acute or subacute bacterial endocarditis, a recent myocardial infarction (within three weeks) or presence of a ventricular aneurysm; and 3. No identified left heart catheterization procedures or cardiac angiogram performed less than forty-eight hours before the onset of symptoms diagnosed as stroke.

The hospital records of all potential cases were reviewed by a specially trained research assistant who was unaware of the research

hypothesis. To assemble the group with stroke, data was extracted from the medical records of all patients listed as having had a thromboembolic stroke in the medical record discharge file during the time period of the study. Patients with stroke who fulfilled the criteria for eligibility in the study were admitted if they had no previous history of stroke and if they fulfilled the diagnostic criteria for thromboembolic stroke. These criteria included supporting head CT evidence of acute stroke and/or certain clinical features. The supporting head CT evidence of stroke required the demonstration of a sharply marginated, homogeneous, speckled low density lesion confined to a specific vascular territory with or without an associated defect in the blood brain barrier, or the absence of CT documentation of intracerebral hemorrhage or other lesions that may present as stroke. The clinical criteria required the acute onset of focal and fixed neurological findings in a specific vascular distribution which lasted more than twenty-four hours and correlated with associated CT findings.

The research assistant extracted pertinent demographic, clinical and paraclinical data using uniform criteria. Special attention was paid to risk factors for stroke such as hypertension, atherosclerosis and diabetes mellitus. Atherosclerosis was defined as the presence of bruit, previous myocardial infarction, angina, claudication or an absent peripheral pulse. Hypertension was defined as an admission blood pressure of 160/100 mmHg or higher, or the documentation of

current treatment for hypertension. Diabetes mellitus was defined by the documentation of current treatment for diabetes mellitus including diet.

The head CT scan was used to document radiologic evidence of acute cerebral infarction, to identify the neuroanatomical and vascular distribution of stroke when present on CT scan and to document infarct related findings such as mass effect. Evidence of non acute stroke pathology such as the presence of cerebral atrophy and lucencies consistent with old ischemic events were also noted.

The head CT scan was categorized as normal or abnormal. If the CT scan were read as abnormal the findings were classified as: 1. Consistent with acute cerebral infarction; 2. Evidence of mass effect; and 3. Presence of non acute stroke pathology such as cerebral atrophy or evidence of old ischemic events. Abnormal CT scan consistent with acute cerebral infarction were subgrouped into anterior or posterior and deep or superficial lesions based on the neuroanatomical location or vascular distribution described in the final radiology report. An anterior lesion was defined as a superficial infarction involving the cortical grey matter in the distribution of the middle cerebral artery. This would include the frontal, parietal and corresponding part of the temporal lobes. A posterior lesion was defined as an infarct involving the grey matter in the distribution of the vertebral-basilar artery and its branches and would include the corresponding anatomic structures in the

temporal and occipital lobes and brainstem. Deep lesions in the white matter corresponding to the deep perforating arteries were classified according to the anatomic structures involved. A watershed lesion was defined as an infarct involving the territory supplied by the distal, anastamotic branches of the anterior, middle and posterior cerebral arteries.

Mass effect was defined as the presence of cerebral edema secondary to infarction causing displacement of neuroanatomical structures. Cerebral atrophy was defined as the presence of increased ventricular size or widened sulci. Evidence of prior ischemic events was defined as the presence of well circumscribed lucencies without edema, often associated with a loss in cerebral volume.

The information concerning short term stroke outcome was obtained from the hospital record. The hospital record specifies the patients' status upon discharge as deceased or alive. For those patients who survive, disposition on discharge is listed as one of the following: 1. Rehabilitation hospital; 2. Interim care facility; 3. Skilled nursing facility; 4. Home with assistance; and 5. Home without assistance. In the group of patients who were discharged to their home with assistance, the assistance required was identified as either a visiting nurse associate or home health aide.

Based on this information we classified the patients' outcome as poor, intermediate or good. Specifically, deceased patients were

classified as poor outcome, patients discharged to a rehabilitative or nursing facility were classified as intermediate outcome, and patients discharged to home with no assistance or with minimal assistance were classified as good outcome.

Data Analysis

The significance of observed differences in the distribution of the individual variables between deceased and surviving patients and between the two categories of surviving patients were tested by the Chi-squared test (with Yates correction) or students t-test.

Results

A. Demographic: The study population was comprised of one-hundred patients, 62 males and 38 females. The age range was 30 to 65 years with a mean age of 57.9. Sixty-nine patients (69%) were white and thirty-one (31%) were nonwhite.

B. Neurological Deficits on Admission: The neurologic findings recorded on the admission physical examination were grouped into the categories shown in Table 1.

Table 1. Prevalence of Neurological Deficits on Admission

DEFICIT	PREVALENCE
Drowsy on admission	8% (8/100)
Comatose on admission	5% (5/100)
Confused mental status	14% (13/95)
Motor hemideficit*	83% (83/100)
Complete limb paralysis	12% (12/100)
Simple sensory deficit	41% (39/95)
Hemianopia	24% (23/95)
Higher cerebral dysfunction**	33% (31/95)
Brainstem deficit***	12% (12/100)

*Defined as hemiparesis, hemiplegia, or unilateral central facial weakness.
**Defined as aphasia and/or parietal deficit as manifest by sensory or visual inattention, visuospatial neglect or joint position sense loss.
***Defined as presence of ataxia, vertigo, dysarthria without aphasia, oculomotor palsy (except conjugate gaze palsy) with or without motor or simple sensory deficit but definetly without higher cerebral dysfunction.

C. Historical Data: Based on findings from other studies, the only historical information extracted from the hospital chart was the state of consciousness at the onset of stroke. Of the 100 patients three (3%) had a history of loss of consciousness at the onset of the stroke.

D. Stroke Subgroups Based on Clinical Diagnosis: In the hospital record, clinicians used various descriptive terms to classify stroke subgroups. Strokes were classified according to neuroanatomical location (i.e. frontal lobe, cerebellar, brainstem) or by vascular distribution (i.e. territory of middle cerebral

artery). Strokes were also classified by stroke syndromes (i.e. lacunar strokes, lateral medullary strokes etc.). For the purpose of this study we combined the above categories and classified strokes according to their location on clinical examination as anterior or posterior cerebral and superficial or deep cerebral. An anterior cerebral stroke was defined as a superficial infarction involving the cortical grey matter in the distribution of the middle cerebral artery. This would include the frontal, parietal, and corresponding part of the temporal lobes. A posterior stroke was defined as an infarct involving the grey matter in the distribution of the vertebral-basilar artery and its branches (i.e. posterior cerebral artery) and would include the corresponding anatomic structures in the temporal and occipital lobes, brainstem, and cerebellum.

Deep strokes in the white matter corresponding to the deep perforating branches of the middle cerebral and vertebral-basilar arteries, often referred to as lacunar strokes, were classified according to the anatomic structures involved (i.e. basal ganglion and thalamus). A watershed stroke was defined as an infarct involving cerebral cortex supplied by the distal, anatastomotic branches of the anterior, middle, and posterior cerebral arteries. The distribution of stroke subgroups according to the final clinical diagnosis is shown in Table 2.

Table 2. Stroke Subgroup: Clinical Diagnosis

STROKE SUBGROUP	PREVALENCE
Anterior cerebral	68% (68/100)
Occipital	5% (5/100)
Brainstem/cerebellar	14% (14/100)
Basal ganglion	9% (9/100)
Thalamus	3% (3/100)
Watershed	1% (1/100)

According to the final clinical diagnosis forty-nine strokes (49%) involved the right cerebral hemisphere, and fifty-one (51%) the left cerebral hemisphere. There were no bilateral strokes by clinical examination.

E. CT Scan Results: All patients in the study received a head CT scan within forty-eight hours of admission. Fifteen patients had more than one CT scan during hospitalization. The head CT scan diagnosis as shown in Table 3 is based on the final CT diagnosis.

Table 3. Head CT Scan Diagnosis

DIAGNOSIS	FREQUENCY
Normal	(51%) 51/100
Abnormal	(49%) 49/100
Evidence of acute infarction	(49%) 49/100
Anterior cerebral	(58%) 28/49
Occipital	(14%) 7/49
Brainstem/cerebellar	(8%) 4/49
Basal ganglion	(16%) 8/49
Thalamus	(2%) 1/49
Watershed	(2%) 1/49
Mass effect	(10%) 5/49
Non-stroke pathology	(14%) 11/49
Cerebral atrophy	(6%) 3/49
Old CVA	(8%) 4/49

Twenty-two of the forty-nine (45%) CT scans with evidence of acute cerebral infarction involved the right cerebral hemisphere and twenty-six (53%) involved the left cerebral hemisphere. Acute infarcts in both hemispheres were diagnosed in one patient. This bilateral stroke was detected radiographically but not clinically in a comatose patient. One patient had CT evidence of both mass effect and cerebral atrophy.

F. Risk factors for cerebral infarction: The frequency of risk factors for cerebral infarction in the stroke patients less than and greater than fifty years of age is shown in Table 4.

Table 4.
Frequency of Risk Factors for Cerebral Infarction in Stroke Patients Less than and Greater than Fifty Years of Age

RISK FACTOR	PATIENTS <50 Years	PATIENTS >50 Years
CAD	11% (1/9)	23% (21/91)
PVD	0% (0/9)	24% (22/91)
DM	22% (2/9)	41% (37/91)
HTN	33% (3/9)(P<.025)	70% (64/91)
NO RISK FACTORS	56% (5/9)(P<.035)	14% (13/91)

There was a statistically significant difference in the frequency of hypertension in the two age groups. In the stroke patients less than 50 years old the frequency of hypertension was 33%. In patients over 50 years the frequency was 70%. In addition, a difference in the number of patients with no risk factors for stroke was found in the two age groups. Significantly more stroke patients less than fifty years old had no identified risk factor for stroke.

The patients with hypertension were further subgrouped by race, age and gender (as shown in Tables 5a, 5b and 5c).

Table 5a. Hypertension Grouped by Race

	WHITE	NON-WHITE
Hypertension (all criteria)*	60%(40/69)	87%(27/31)(p=.004)
Systolic blood pressure >160mmHg	36%(25/69)	68%(21/31)(p=.003)
Diastolic blood pressure>100mmHg	26%(18/69)	61%(19/31)(p=.0007)

Table 5b. Hypertension Grouped by Age

	<50 YEARS	>50 YEARS
Hypertension (all criteria)*	33%(3/9)	70%(64/91)(p=.024)
Systolic blood pressure >160 mmHg	11%(1/9)	49%(45/91)(p=.028)
Diastolic blood pressure > 100 mmHg	33%(3/9)	37%(34/91)(p=.81)

Table 5c. Hypertension Grouped by Gender

	MALE	FEMALE
Hypertension (all criteria)*	61% (38/62)	76%(29/38)(p=.12)
Systolic blood pressure > 160 mmHg	35% (22/62)	63%(24/38)(p=.007)
Diastolic blood pressure >100 mmHg	32% (20/62)	46%(17/38)(p=.20)

*Hypertension was defined as an admission blood pressure of 160/100 mmHg or higher, or the documentation of current treatment for hypertension.

G. Outcome Events: The clinical and paraclinical data were analyzed for two separate dichotomous outcome possibilities. The first set of outcome events was death versus survival during hospitalization for stroke. In surviving patients, the second set of outcome events was discharge to home versus transfer to an institution (rehabilitation, skilled nursing, or an interim nursing facility). The frequency of outcome events is shown in Table 6.

Table 6. Frequency of Outcome Events

OUTCOME	FREQUENCY
Dead	5/100 (5%)
Institution	27/100 (27%)
Home	68/100 (68%)

Of the surviving patients, 68 (72%) were discharged to home and 27 (28%) to an institution.

H. Clinical and Paraclinical Variables Associated with Stroke Outcome: The chi-square analysis of the significance of observed differences in the distribution of individual variables between deceased and surviving patients and the two categories of surviving patients is shown in Tables 7, 8, and 9.

Table 7. Variables Unrelated to Stroke Outcome (p>0.05)

Age	Higher cerebral dysfunction
Gender	Lateralization
Race	Basal ganglion stroke
Blood pressue	Occipital stroke
Motor hemideficit	Thalamic stroke
Sensory deficit	Watershed stroke
Hemianopia	History of loss of consciousness
	Cerebral atrophy by head CT scan
	Old CVA by head CT scan

Table 8. Variables Associated with Death During Hospitalization

VARIABLE	DECEASED PATIENTS WITH VARIABLE	TOTAL PATIENTS WITH VARIABLE	p VALUE
Neurologic Deficits:			
Comatose on admission	2	4	.0001
Complete limb paralysis	3	12	.0008
CT Scan Findings:			
Bilateral stroke	1	1	.005
Anterior cerebral stroke	4	25	.037
Mass effect	3	5	.0005

Complete limb paralysis, although associated with death from stroke at a significant level, was never an isolated finding in

deceased or surviving patients. Two of the twelve patients with complete limb paralysis were comatose on admission and three were drowsy. In addition, all had either hemianopia, higher cerebral dysfunction or sensory deficit. Similarly, two of the four patients who died with an anterior cerebral stroke had mass effect on CT scan, and one of the four had CT evidence of bilateral infarcts.

Table 9. Variables Associated with Discharge to an Institution in Stroke Patients who Survived

VARIABLE	PATIENTS DISCHARGED TO INSTITUTION WITH VARIABLE	TOTAL PATIENTS WITH VARIABLE	p VALUE
Neurologic Deficits:			
Confused mental status	6	11	.0364
Complete limb paralysis	5	9	.0491
Brainstem stroke	8	14	.0099
CT Scan Abnormalities:			
Brainstem stroke	3	7	.0288
EKG Conduction Abnormalities:	6	12	.0462

Of the twelve patients with EKG conduction abnormalities, ten had intraventricular conduction defects, one had first degree atrioventricular block and one had second degree atrioventricular block.

Discussion

Stroke fatalities, in most developed countries, rank third as the most frequent causes of death, surpassed only by heart disease and cancer. There are 500,000 new strokes in the United States each year. Two-thirds of these strokes are thromboembolic, with the remaining one-third equally divided between cerebral embolus and cerebral hemorrhages. Each of these has a related but different disease process with a distinct etiology and prognosis. In this paper, we describe the characteristics of a young population who presented with a first thromboembolic stroke and identify features which predict short-term stroke outcome.

The study population was comprised of 62 males and 38 females. The age range was 30 to 65 years with a mean age of 58. The male predominance in our study was also observed in the Framingham Study. They found in the age group between 45 and 65 years a male:female ratio of 56:44. It has been theorized that the smaller percentage of females is due to premenopausal immunity.

In the present study of 100 stroke patients, five died in the hospital, 27 were transferred to a nursing or rehabilitative facility, and 68 were discharged to home. Allen[1] found, at two months after stroke onset, 21% of his patients were dead, 15% were incapable of living alone and 64% were functionally capable of living alone. Possible explanations for the greater mortality in the Allen investigation as compared to ours include the following: (1) His

patients were older - the age ranged up to 76 years; (2) all stroke types were included in the study population. Allen did not separate hemorrhagic strokes, with their uniformly poor prognosis, from thromboembolic stroke; and (3) the study is based on a British patient population. In Britain not all strokes are hospitalized and this may therefore limit the hospital stroke spectrum to more severely afflicted patients. The increased severity of his patients' strokes is evidenced by their profound neurological deficits. The admission physical exam in our study showed that 4% of the patients were comatose, 8% were drowsy and 13% were hemiplegic on admission. In Allen's study, 34% were comatose or drowsy on admission and 45% were hemiplegic.

In a Swedish study by Frithz,[6] adjustments were made for age and stroke subgroups. In a group of patients less than 59 years old hospitalized with first thromboembolic stroke, he found a 19% mortality during hospitalization. Of the patients who survived, half were transferred to an institution and half were discharged to home. When the neurological deficits noted on admission are considered, Frithz's patients were more ill than ours. Specifically, 57% of his patients were somnolent, semicomatose or comatose upon admission to the hospital.

The neuroanatomical distribution of strokes in our study is comparable to the Harvard Stroke Registry.[11] We found on clinical exam, 68% of the strokes were anterior cerebral infarctions,

14% were brainstem/cerebellar strokes and 12% were lacunar strokes. The Harvard Stroke Registry reported 65% anterior cerebral infarctions, 16% brainstem/cerebellar, and 19% lacunar strokes. Based on our results, strokes in the young population have a similar neuroanatomical distribution to the general stroke population.

There was a high prevalence of risk factors for stroke in our young stroke population. Sixty-seven percent of our patients had hypertension, 39% had diabetes, 22% had peripheral vascular disease and 22% had coronary artery disease. Only 16% of the patients had no known risk factors for stroke. These results are comparable to those reported in patients under 65 years presenting with first thromboembolic stroke in the Oxfordshire Community Stroke Project[12] and in the general stroke population.

There is controversy regarding the diagnosis of hypertension in an acute stroke. Marquardsen[13] points out that acute infarction may cause a transient rise in blood pressure. Studies such as ours, which accept an increased blood pressure on admission as adequate criteria for diagnosing hypertension, are questioned as to whether it leads to an overestimation of the prevalence of hypertension. In our study, blood pressure readings were evaluated after the patient was admitted to the medical ward. Our data show that 74% of patients who met the criteria for hypertension were currently receiving antihypertensive medication.

The present study found that black patients were significantly

more likely to have hypertension than white patients. These data are in accordance with several studies which find hypertension in blacks more prevalent than whites in each age group.

All patients in our study received a head CT scan within 48 hours of admission to exclude cerebral hemorrhage and other entities that could present as stroke. A later CT scan may have maximized the ability to diagnose cerebral infarction. Campbell,[14] using sequential CT scans, found that 48% of stroke patients had a scan with evidence of infarction one day post ictus and 74% had infarct evidence by day 10. Our study was comparable; 49% showed focal abnormalities within 48 hours of admission for stroke.

Forty-nine percent of the 100 stroke patients studied showed CT scan evidence of an acute cerebral infarction. The large percentage of normal scans makes it possible to precisely compare radiographic and clinical results. However, in the patients with positive CT scans there was a good correlation between the CT scan results and the clinical diagnosis with respect to the neuroanatomical location of the infarction. Some strokes were diagnosed more frequently by CT scan than by clinical exam. For example, five occipital strokes were clinically diagnosed from the total population of 100 patients, whereas seven occipital strokes were deduced radiographically in the group of 49 patients with abnormal scans. We suspect that some occipital strokes were clinically misclassified. Specifically, patients who exhibited both anterior cerebral deficits and a

hemianopia were commonly diagnosed as having had an anterior cerebral infarction. Middle cerebral artery occlusion can cause an infarction in the anterior cerebrum including the optic striations. Other infarctions, however, may principally involve the occipital area and the anterior cerebrum to a lesser degree.

Strokes in the basal ganglion were diagnosed by clinical exam in nine of the 100 patients, whereas eight were diagnosed by CT scan in the group of 49 patients with abnormal CT scans. The basal ganglion infarction presents as a pure motor stroke. Diagnosis by clinical exam may have underestimated its prevalence because a pure motor stroke may be difficult to recognize.

The present study found fewer significant predictors of stroke outcome than previous studies, probably due to the fact that there were only five deaths in our stroke population and of the patients who survived, only 28% required discharge to an institution. We found five variables which predicted death during hospitalization for stroke. These variables were interrelated. Each deceased patient had more than one predictor of death. For example, anterior cerebral strokes were found to be predictive of death. Four of the five patients who died with anterior cerebral strokes, however, also had either mass effect on head CT scan, a bilateral stroke, or coma on admission. Other variables which predicted death included coma on admission, complete limb paralysis, mass effect and bilateral stroke. These clinical findings are all associated with large infarcts or

multivessel cerebrovascular disease. Oxbury[2] noted that stroke patients who were comatose or drowsy on admission commonly had large cerebral infarcts. Inoue[15] found that mass effect depended on the size of the cerebral infarction. Miller[9] found that larger infarcts on CT scan had poorer functional recovery than smaller infarcts.

There were several variables associated with transfer to nursing or rehabilitative facilities following hospitalization for stroke. We found EKG conduction abnormalities, the majority of which were bundle branch blocks, to be one of those variables. Miah[4] found that bundle branch was a significant predictor of poor short and long term stroke outcome. He attributed this to global arteriosclerosis and its attendant cardiac mortality. Complete limb paralysis was not only predictive of death but institutionalization as well. This was not an isolated finding and was usually associated with other functional deficits. Brainstem strokes, as diagnosed either by CT scan or clinical exam, were predictive of transfer to an institution after hospitalization. Teleologically, this makes sense; patients with ataxia, vertigo or dysarthria may be more likely to need nursing or rehabilitative assistance. Confused mental status on admission was also predictive of institutionalization. If their confused mental status persisted, the patient may be incapable of returning home. We do not have data on the patients' mental status upon discharge. This would be valuable information for future studies.

Several conclusions can be drawn from this investigation: results from this study indicate that the demographic, clinical and paraclinical characteristics of a young stroke population are comparable to the general stroke population. Of special interest, there was a notably high prevalence of hypertension, diabetes mellitus, peripheral vascular disease and coronary artery disease in patients under 65 years old presenting with first thromboembolic stroke. Stroke outcome is predictable from the initial exam. Patients with direct or indirect evidence of massive strokes (i.e. coma on admission, complete limb paralysis associated with other higher cerebral findings, mass effect and bilateral stroke on CT scan) do poorly. Other factors described by previous investigators, such as age or associated disease processes, were not found to be significant predictors in our study. We found that head CT scan results do not add significant predictive value except when they provide additional indirect evidence of a massive stroke (mass effect and bilateral stroke). The CT scan, if abnormal, may be more useful in specifying the location of cerebral infarcts such as lacunar occipital and bilateral strokes.

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